OXFORD

INTERNATIONAL
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Please write clearly in block capitals.

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I declare this is my own work.

INTERNATIONAL AS
BIOLOGY (9610)

Unit 1 The Diversity of Living Organisms

Tuesday 14 January 2020 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided.
  Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

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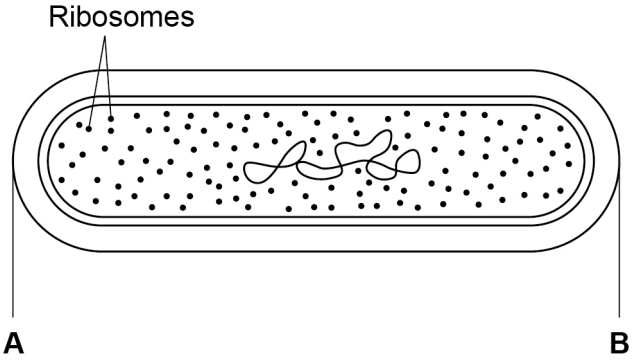
Answer **all** questions in the spaces provided.

0 1 **Figure 1** shows a prokaryotic cell.

Figure 1



0 1 . 1 The actual length of the cell from point **A** to **B** is 4 μm

Calculate the magnification of the image in **Figure 1**.

[1 mark]

Magnification = _____

0 1 . 2 Both prokaryotic and eukaryotic cells can have cell walls and ribosomes.

Complete **Table 1** by stating **one** way in which each feature is different in a prokaryotic cell from that in a eukaryotic cell.

[2 marks]

Table 1

Feature	**Prokaryotic cell**
Cell wall	
Ribosomes	

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0 1 . 3 Tetracycline is an antibiotic that attaches to ribosomes.

Suggest how tetracycline stops bacteria from dividing.

[3 marks]

6

Turn over for the next question

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0 2 A group of students investigate the effect of temperature on the hydrolysis of lipids in milk.

The students:

- add 5 cm^3 of milk and 7 cm^3 of sodium carbonate solution to a test tube
- add 5 drops of the pH indicator phenolphthalein to give the mixture a pink colour
- put the test tube in a water bath at 30 ^oC
- after 5 minutes, add 1 cm^3 of lipase to the test tube and start timing immediately
- stir the contents of the test tube continuously
- record the time taken for the pink colour to disappear
- repeat the experiment at three other temperatures.

Phenolphthalein turns a pink colour in alkaline solutions but becomes colourless in solutions with a pH below 8.2

0 2 . 1 The method states how some variables are controlled.

Give **two** other variables the students should control in this investigation.

[2 marks]

1 _____

2 _____

0 2 . 2 Give **one** reason why the students put the test tube in a water bath for 5 minutes before adding the lipase.

[1 mark]

_____

_____

_____

0 2 . 3 In this investigation, the students did **not** add a buffer solution to the test tubes containing milk.

Give the reason why.

[1 mark]

_____

_____

_____

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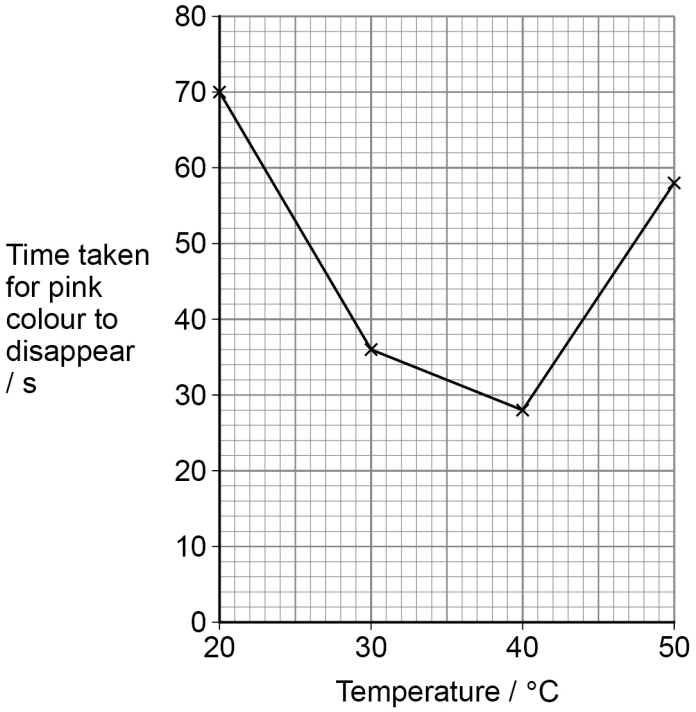
Figure 2 shows the students' results.

Figure 2



0 2 . 4 A student concludes that 40 °C is the optimum temperature for lipase.

Explain why this conclusion might **not** be correct.

Use information from **Figure 2**.

[2 marks]

0 2 . 5 Explain the effect of temperature on lipase activity as shown in **Figure 2**.

[3 marks]

The answer space for Question 02.5 continues on the next page

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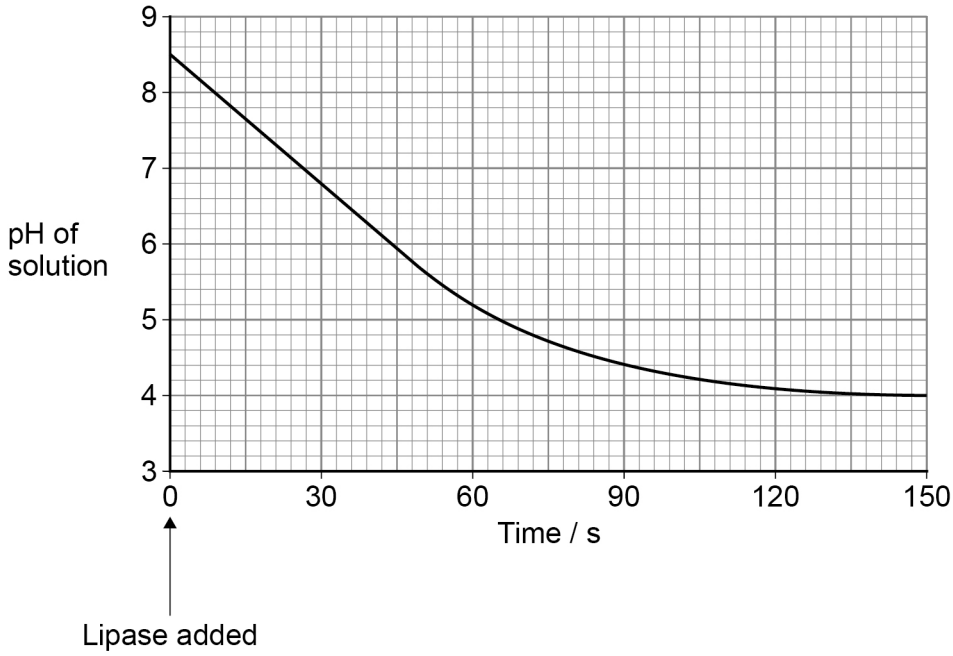
The students then complete a similar experiment but this time they use a pH probe attached to a data logger instead of adding phenolphthalein.

The data logger records the pH of the solution.

Figure 3 shows the students' results at a temperature of 40 °C

Figure 3



0 2 . 6 Draw a tangent on the graph (**Figure 3**) at 60 seconds.

Calculate the rate of change of pH at 60 seconds using the tangent.

[2 marks]

Rate of change at 60 seconds = _____ pH units s^{-1}

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0 2 . 7 Explain the changes in pH shown in **Figure 3**.

[3 marks]

14

Turn over for the next question

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0 3 A dialysis machine is used to treat people with kidney failure.

Inside the dialysis machine are narrow tubes made of artificial membranes.

Artificial membranes and plasma membranes are both partially permeable.

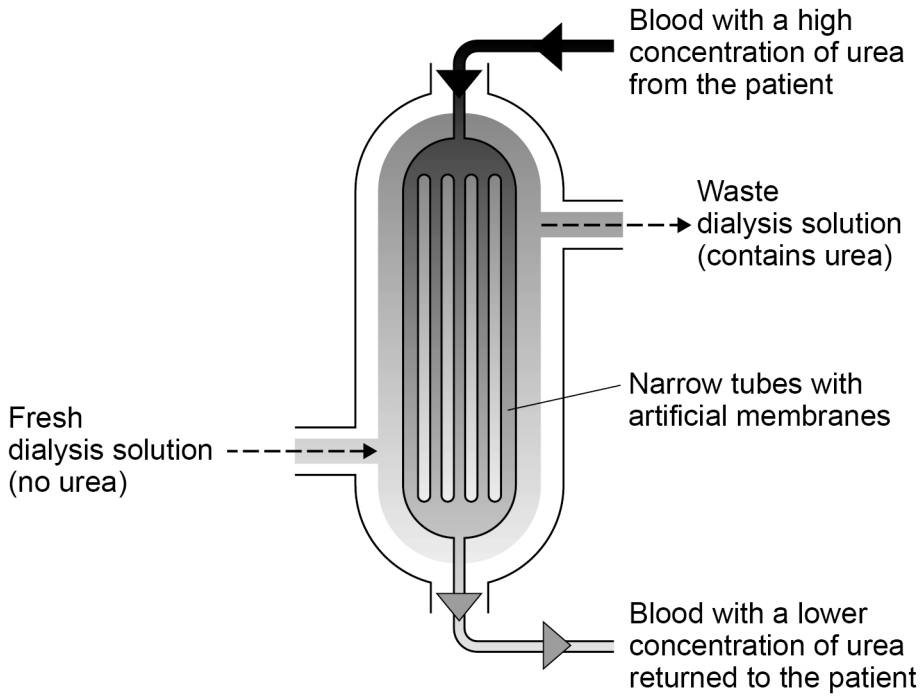
0 3 . 1 Describe how phospholipids are arranged in a plasma membrane.

[2 marks]

The blood from a person with kidney failure flows through the narrow tubes in the dialysis machine and waste products such as urea are removed.

Figure 4 shows the structure of a dialysis machine.

Figure 4



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0 3 . 2 Use information from **Figure 4** to suggest the process by which urea moves from the patient's blood into the dialysis fluid.

[1 mark]

_____

0 3 . 3 Explain **one** way that the dialysis machine shown in **Figure 4** provides an effective exchange surface for removing large amounts of waste products from the body.

[2 marks]

_____

_____

_____

_____

_____

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Question 3 continues on the next page

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0 3 . 4 The blood of a patient with kidney failure flows through a dialysis machine at a rate of 220 cm^3 per minute.

Calculate the total volume that flows through the machine in 4 hours.

Give your answer in dm^3

[1 mark]

Total volume of blood = _____ dm^3

The patient's doctor wants to make sure that the patient's dialysis has been adequate. The doctor calculates a value called dialysis adequacy. This value should be greater than 1.2

$$\text{Dialysis adequacy} = \frac{V}{m}$$

V = total volume of blood filtered during the dialysis (dm^3)

m = mass of water in the patient's body (kg)

The patient has a mass of 80 kg and 60% of this is water.

0 3 . 5 The doctor has determined that the patient's current dialysis treatment is **not** adequate.

Calculate the dialysis adequacy value to show how the doctor determined this.

[2 marks]

Dialysis adequacy = _____

8

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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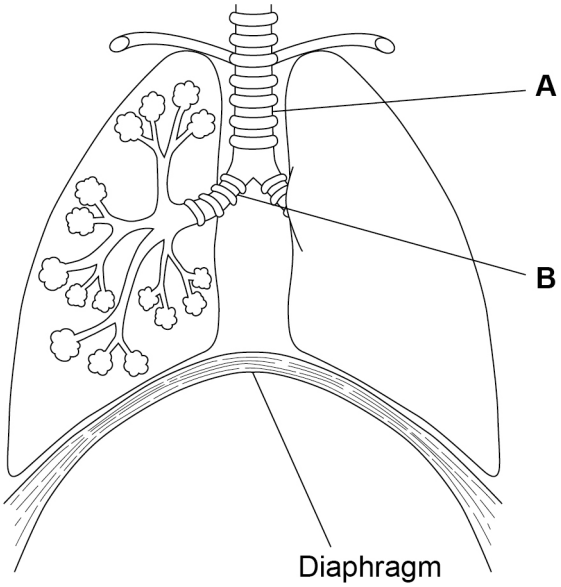
0 4 **Figure 5** shows the structure of the human gas exchange system.

Figure 5



0 4 . 1 Name the structures labelled **A** and **B**.

[1 mark]

A _____

B _____

0 4 . 2 Describe the mechanisms that cause air to move into the lungs.

[3 marks]

_____

_____

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0 4 . 3 A student plans an investigation to compare the resting breathing rates of people with different fitness levels.

The student suggests the hypothesis:

'People with higher fitness levels have lower resting breathing rates.'

Describe a method that could be used to test if this hypothesis is valid.

Include a statistical test that the student could use to analyse the results.

[5 marks]

9

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0 5 All living organisms have genetic information in the form of DNA. This DNA contains genes arranged in a genome.

0 5 . 1 Define the terms **gene** and **genome**.

[2 marks]

Gene _____

_____

Genome _____

_____

0 5 . 2 There are differences in the DNA found in different organisms.

Put a tick (✓) in each box on **Table 2** if the statement is true.

[3 marks]

Table 2

	Prokaryotic cell	**Eukaryotic cell**	**Mitochondrial DNA**
Genetic material held in a nucleus			
Histones present			
DNA in the form of linear molecules			
DNA found as a double helix structure			

5

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0 6 Scientists investigate the effect of disulfide bonds on the structural strength of a human cardiac muscle protein called titin.

The scientists:

- artificially place disulfide bonds into some titin molecules
- apply a force to stretch these modified titin molecules
- repeat the procedure for naturally-occurring titin proteins that did not contain any disulfide bonds
- measure the final lengths of the stretched titin molecules with and without disulfide bonds.

0 6 . 1 The method used by the scientists alters the tertiary structure of the titin protein.

What is meant by the term **tertiary structure**?

[1 mark]

_____

_____

_____

0 6 . 2 The scientists modified some of the amino acids in the protein to create disulfide bonds.

Name the part of these amino acids that the scientists modified.

[1 mark]

_____

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0 6 . 3 Name **two** types of bonds that are most likely to have been broken during the stretching process.

[1 mark]

1 _____

2 _____

Table 3 shows the scientists' results.

Table 3

	Stretched length / nm
Titin without disulfide bonds	28.4
Titin with disulfide bonds	12.7

0 6 . 4 The final length of the stretched titin molecules **without** the disulfide bonds was longer than the titin with disulfide bonds.

Suggest why.

[2 marks]

_____

_____

_____

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_____

Question 6 continues on the next page

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0 6 . 5 Describe briefly **four** ways the scientists could have ensured valid and accurate results.

[4 marks]

1 _____

_____

2 _____

_____

3 _____

_____

4 _____

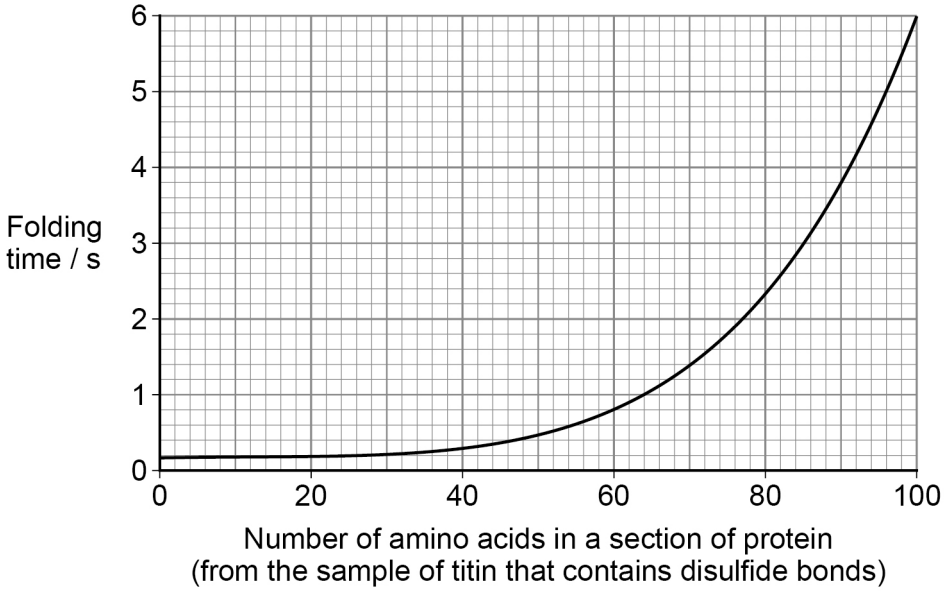
_____

The scientists do a second experiment to measure the time needed for the sections of the stretched titin proteins containing disulfide bonds to refold back into their tertiary structure.

The scientists find that the number of amino acids in the section of the protein that had to refold affects the folding times.

Figure 6 shows the scientists' results.

Figure 6



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0 6 . 6 Describe the relationship between folding time and the number of amino acids.

Use data from **Figure 6**.

[2 marks]

_____

_____

_____

_____

0 6 . 7 Name the molecules found in cells that ensure the correct folding of polypeptide chains.

[1 mark]

_____

The scientists find that it takes 150 times longer to refold the titin proteins which did not contain the disulfide bonds compared with the ones with disulfide bonds.

0 6 . 8 Calculate the time it would take to refold 80 amino acids from a titin protein that does **not** contain disulfide bonds.

Use information from **Figure 6**.

[2 marks]

Answer = _____ seconds

0 6 . 9 Suggest why a stretched protein with disulfide bonds takes less time to refold than a protein without disulfide bonds.

[2 marks]

_____

_____

_____

_____

16

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0 7 To pass genes to their children, parents use cells called germ cells to create gametes. Germ cells undergo two divisions in meiosis to produce sperm and egg cells.

Crossing over occurs during meiosis. The process of crossing over introduces genetic variation. Data has now shown that crossing over can also affect the rate at which genes mutate.

Using genetic data from 155 280 people living in Iceland, researchers at a biotechnology company located in Reykjavík have created the most detailed map yet of the relative locations of genes in the human genome. By looking at the differences in parent and child DNA, the researchers could trace both crossing over and mutations in DNA as it passed from parent to child. Mutations were approximately 50 times more common in sections of DNA within about 1000 base pairs of where crossovers had happened. The number of mutations decreased with increasing distance from a crossover site.

Understanding how mutations happen can help biologists study how genetic diversity is created and give insights into disorders caused by mutations.

Use information from the passage and your own knowledge to answer the questions.

0 7 . 1 Explain why germ cells need to undergo two divisions in meiosis to produce sperm and egg cells (lines 1–2).

[3 marks]

Do not write outside the box

0 7 . 2 Crossing over, independent segregation and mutation all result in genetic diversity.

Name **one** other process that can further increase genetic variation within a species.

[1 mark]

_____

0 7 . 3 In Iceland, 1 in 80 people have some kind of genetic disease.

Calculate the number of people who have a genetic disease in the data set used in this study.

[1 mark]

Answer = _____

0 7 . 4 'Crossing over occurs during meiosis' (line 4).

Explain how the process of crossing over results in genetic variation.

[4 marks]

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Question 7 continues on the next page

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0 7 . 5 Which row in **Table 4** shows the stages in cell division when independent segregation and crossing over take place?

Tick (✓) **one** box.

[1 mark]

Table 4

	Independent segregation	**Crossing over**	Tick (✓) **one** box
A	anaphase I	prophase I	
B	metaphase I	anaphase I	
C	metaphase I	prophase I	
D	prophase I	metaphase I	

10

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 8 Keratin is a structural protein found in the hair of mammals.

Scientists have determined the sequence of the amino acids in keratin from different species.

Table 5 shows the sequences of amino acids in one section of keratin from the hair of humans and some apes.

Table 5

Mammal	**Amino acid name**						
Chimpanzee	Met	Trp	Phe	Glu	Pro	Ala	Glu
Gorilla	Met	Trp	Phe	Lys	Pro	Pro	Glu
Human	Met	Trp	Phe	Glu	Pro	Ala	Glu
Orangutan	Met	Trp	Phe	Glu	Pro	Pro	Glu

0 8 . 1 Give the number of nucleotides that code for the amino acid sequence of human keratin shown in **Table 5**.

[1 mark]

0 8 . 2 Explain the conclusions the scientists could make about the evolutionary relationships between humans and apes.

Use the information from **Table 5**.

[3 marks]

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0 8 . 3 Any conclusions made by the scientists based **only** on the data in **Table 5** may not be valid.

Discuss why.

[3 marks]

_____

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7

END OF QUESTIONS

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